



(11)

**EP 4 269 754 A3**

(12)

## EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
**10.04.2024 Bulletin 2024/15**

(51) International Patent Classification (IPC):  
**F01D 5/14 (2006.01)** **F01D 5/18 (2006.01)**  
**F01D 9/06 (2006.01)**

(43) Date of publication A2:  
**01.11.2023 Bulletin 2023/44**

(52) Cooperative Patent Classification (CPC):  
**F01D 5/147; F01D 5/189; F01D 9/065;**  
F05D 2230/211; F05D 2240/126; F05D 2250/75;  
F05D 2260/221; Y02T 50/60

(21) Application number: **23196960.1**

(22) Date of filing: **12.11.2020**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB**  
**GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO**  
**PL PT RO RS SE SI SK SM TR**

(30) Priority: **13.11.2019 US 201916682453**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:  
**20207281.5 / 3 822 455**

(71) Applicant: **RTX Corporation**  
**Farmington, CT 06032 (US)**

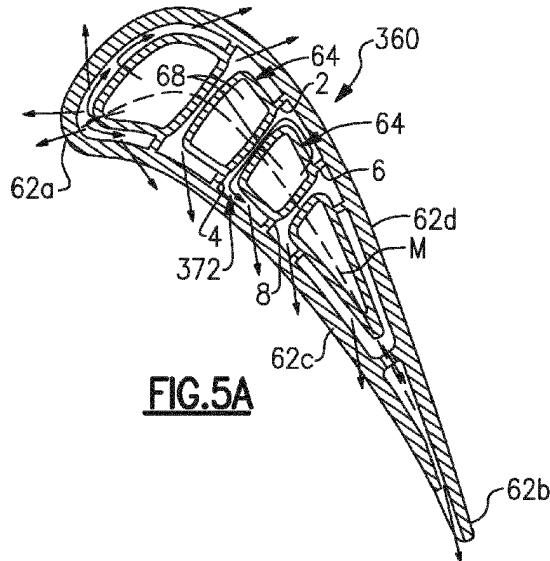
(72) Inventors:  

- SPANGLER, Brandon W.**  
**Vernon (US)**
- PACK, David R.**  
**Gold Canyon (US)**

(74) Representative: **Dehns**  
**St. Bride's House**  
**10 Salisbury Square**  
**London EC4Y 8JD (GB)**

### (54) AIRFOIL WITH RIBS DEFINING SHAPED COOLING CHANNEL

(57) An airfoil (60) includes an airfoil wall (62) that defines a leading end (62a), a trailing end (62b), a pressure side (62c), a suction side (62d), and a mean line (M). First and second ribs (64) each connect the pressure side (62c) and the suction side (62d). Each of the first and second ribs (64) define a tube portion (66) that circumscribes a rib passage (68), and first and second connector arms (1, 2, 5, 6, 3, 4, 7, 8) that solely join the tube portion (66) to, respectively, the pressure side (62c) and the suction side (62d). The first rib (64), the second rib (64), and the airfoil wall (62) bound a continuous cooling channel (72) there between. The continuous cooling channel (72) has a pressure side portion (72a) to the pressure side of the mean line (M) and a suction side portion (72b) to the suction side of the mean line (M). The pressure side portion (72a) and the suction side portion (72b) each have a cross-sectional shape that is an L-shape.





## EUROPEAN SEARCH REPORT

Application Number

EP 23 19 6960

5

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
10	X US 5 624 231 A (OHTOMO FUMIO [JP] ET AL) 29 April 1997 (1997-04-29) * column 10, lines 23-48; figure 7 * -----	1,5-10	INV. F01D5/14 F01D5/18 F01D9/06
15	E EP 3 783 198 A1 (RAYTHEON TECH CORP [US]) 24 February 2021 (2021-02-24) * paragraph [0042]; figure 6 * -----	1-3,8-10	
20	A WO 2015/171145 A1 (SIEMENS ENERGY INC [US]) 12 November 2015 (2015-11-12) * page 11, line 16 - page 12, line 4; figures 1,4 * * page 7, lines 10-20; claim 8 * -----	1-10	
25	A WO 2017/039572 A1 (SIEMENS AG [DE]; SIEMENS ENERGY INC [US]) 9 March 2017 (2017-03-09) * paragraphs [0017], [0026]; figure 6 * -----	1-10	
30	A US 2012/269647 A1 (VITT PAUL H [US] ET AL) 25 October 2012 (2012-10-25) * paragraph [0024]; figure 2 * -----	1-10	TECHNICAL FIELDS SEARCHED (IPC)
35	A WO 2015/195086 A1 (SIEMENS ENERGY INC [US]) 23 December 2015 (2015-12-23) * page 6, line 30 - page 7, line 11; figures 2,4 * -----	1-10	F01D
40			
45			
50	1 The present search report has been drawn up for all claims		
55	Place of search Munich	Date of completion of the search 20 November 2023	Examiner Teusch, Reinhold
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document			



Europäisches  
Patentamt  
European  
Patent Office  
Office européen  
des brevets

Application Number  
EP 23 19 6960

5

## CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

10  Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

15  No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

## LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

20 see sheet B

25  All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

30  As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

35  Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

40  
45  None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-10

50  
55  The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



5

**LACK OF UNITY OF INVENTION  
SHEET B**Application Number  
EP 23 19 6960

10

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

**1. claims: 1-10**

15

Airfoil with two ribs, each comprising a tube portion joined solely by a first and a second connector arm to the pressure side and the suction side, the ribs and the airfoil wall bounding a continuous cooling channel there between, the pressure side portion and the suction side portion of this cooling channel each having a cross-sectioned shape that is an L-shape.

---

20

**2. claim: 11**

25

Airfoil with two ribs, each comprising a tube portion joined solely by a first and a second connector arm to the pressure side and the suction side, the ribs and the airfoil wall bounding a continuous cooling channel there between, the first connector arm and/or the second connector arm being an extension of a side wall of the tube portion.

---

30

35

40

45

50

55

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 23 19 6960

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-11-2023

10	Patent document cited in search report	Publication date		Patent family member(s)	Publication date
15	US 5624231 A 29-04-1997	JP JP US	3651490 B2 H07189602 A 5624231 A	25-05-2005 28-07-1995 29-04-1997	
20	EP 3783198 A1 24-02-2021	EP US	3783198 A1 2021054746 A1	24-02-2021 25-02-2021	
25	WO 2015171145 A1 12-11-2015	EP US WO	3140515 A1 2017101893 A1 2015171145 A1	15-03-2017 13-04-2017 12-11-2015	
30	WO 2017039572 A1 09-03-2017	CN EP JP US WO	108026773 A 3322880 A1 6594525 B2 2018529043 A 2019024515 A1 2017039572 A1	11-05-2018 23-05-2018 23-10-2019 04-10-2018 24-01-2019 09-03-2017	
35	US 2012269647 A1 25-10-2012	CN EP US WO	103492677 A 2699763 A1 2012269647 A1 2012145121 A1	01-01-2014 26-02-2014 25-10-2012 26-10-2012	
40	WO 2015195086 A1 23-12-2015	CN EP JP JP US WO	106471212 A 3158169 A1 6239163 B2 2017527727 A 2017089207 A1 2015195086 A1	01-03-2017 26-04-2017 29-11-2017 21-09-2017 30-03-2017 23-12-2015	
45					
50					
55					